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REMARKS

By this amendment, claims 15 – 21 are canceled; new claims 22 – 37 are presented; and claims 1 – 14 and 22 – 37 are pending. Claims 1, 5-7 and 11-14 stand rejected as anticipated by *LeBlanc*; claims 2-4 and 8-10 stand rejected as obvious in view of *LeBlanc*, *Henningsen* and/or *Cizmer*; and claims 15-21 were withdrawn from examination due to a restriction requirement. Claim 14, previously withdrawn due to a restriction requirement, has been rejoined for examination as claim 14 is a linking claim. Further examination of the application, as amended and reconsideration of the rejections are respectfully requested.

No New Matter

New claims 22 – 37 have been added to emphasize that the reactor effluent from the POX reactor is at a temperature greater than 1100°C and/or that the POX reactor is a non-catalytic reactor. Support for these limitations can be found, inter alia, in the specification at original paragraphs [0003] incorporating references directed to POX reactors disclosing free flow, unpacked, non-catalytic partial oxidation reactors where the reactor effluent is at a temperature between 1300°F to 3500°F (700°C to 1650°C). Support for claims 26 – 37 can be found, inter alia, in amended claims 2 – 6 and in original claims 7 – 13 as previously presented; support for heat recovery from the first reactor effluent can be found in the specification at paragraph [0011].

§ 102 Rejections

There are at least three types of reactors that are well-known in the art for producing syngas: (1) steam reformers (also abbreviated as SMR), (2) autothermal reformers (also abbreviated as ATR), and (3) partial oxidation or POX reactors. In steam reformers, steam and hydrocarbon without added air or oxygen are fed to catalyst-filled tubes heated in a radiant furnace. In autothermal reformer reactors,

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hydrocarbon feed with air (or oxygen) and steam are supplied to an adiabatic catalytic reactor where the exothermic reaction of the hydrocarbon with the oxygen provides the heat needed for the endothermic hydrocarbon reforming. In POX reactors, the hydrocarbon and oxygen source are fed to a specially designed burner in a generally non-catalytic reactor where the partial combustion of the hydrocarbon provides the heat for the reforming reaction. While all three technically involve oxidation of the hydrocarbon feed, it is understood in the art that the term "partial oxidation reactor" refers to the POX reactor as distinguished from the SMR or ATR. In other words, to one skilled in the syngas production arts, the term "partial oxidation reactor" is a term of art that refers to a syngas reactor with a specially designed burner to increase the temperature of the hydrocarbon feed by partial combustion thereof, and not generically to all syngas production reactors in which any partial oxidation occurs.

Claim terms are presumed to have the ordinary and customary meanings attributed to them by those of ordinary skill in the art. Sunrace Roots Enter. Co. v. SRAM Corp., 336 F.3d 1298, 1302, 67 USPQ2d 1438, 1441 (Fed. Cir. 2003); MPEP 211.01(II). It is respectfully submitted that claim terms are interpreted as they would be understood by one of skill in the particular art, not by a lay person unfamiliar with the technology. It is further submitted, respectfully, that the term "partial oxidation reactor" as used in applicant's claims herein is such a term of art that does not encompass either ATR or SMR reactors and is hence structurally distinguishable therefrom.

By way of background, the present invention uses a reforming exchanger in combination with a POX reactor in a new hydrogen plant with improved efficiency and reduced steam export, or in an existing hydrogen plant. The hydrogen capacity can be increased by as much as 20 to 30 percent, with reduced export of steam from the hydrogen plant. The process includes: (a) partially oxidizing part of the

hydrocarbon feed with oxygen in a POX reactor; (b) cooling the POX reactor effluent to 650° - 1000°C; (c) feeding the cooled POX reactor effluent to a reforming exchanger or 'KRES unit'; (d) passing a second part of the hydrocarbon feed with steam through a catalyst zone in the KRES unit; (e) mixing the KRES reactor effluent from the catalyst zone with the effluent from the POX reactor; (f) using the admixture in the KRES unit to heat the catalyst zone; and (g) collecting the admixture from the KRES unit. The apparatus employs a means for each of these operations, and the retrofit method employs generally corresponding steps. See claims 1 and 14.

The affirmatively recited cooling step, part (b), can include introducing water into the first reactor effluent as a quench fluid (see claims 2, 16), indirect heat exchange (see claims 5, 6, and 17), or a combination of water quenching and indirect heat exchange (see claims 3, 4, and 19). The indirect heat exchange can be used to preheat the second hydrocarbon portion in a cross exchanger (see claims 4, 6, and 18). The temperature of the reformer catalyst tube effluent gas is desirably as hot as the materials of construction of the reforming exchanger will allow, e.g. from 750° to 1000°C in the standard KRES unit, where the heat is supplied by the combined effluents of the POX reactor and the reforming exchanger (paragraph [0017]). Thus, the temperature and rate of the cooled POX reactor effluent must not be such that the temperature of the reforming exchanger will exceed or fall below the design parameters.

Leblanc discloses a KRES-type reforming exchanger used with a catalytic exothermic steam reforming reactor, referred to in the art as an autothermal reformer or ATR. In contrast, the present invention utilizes an unpacked, non-catalytic, usually smaller POX reactor producing a much hotter effluent that is not disclosed or suggested anywhere in *LeBlanc*. Additionally, the flow configuration as claimed in the present application cools the effluent from the first reactor

upstream from the KRES unit, a step which is nowhere seen in *LeBlanc*. *LeBlanc* thus fails to anticipate any claims of the present application.

The office action asserts that the <u>step of cooling</u> is met by *LeBlanc* as *LeBlanc* discloses a reactor gas effluent temperature of between 900°C and 1100°C. Applicant produces a reactor gas effluent which is <u>subsequently</u> cooled in a cooling step, as claimed in claim 1. If a difference is found between the claimed invention and the prior art, the claimed invention does not lack novelty and cannot be rejected under 35 U.S.C. 102. See MPEP 2106(VI). A process having a reactor effluent temperature that might be within a particular range cannot be explicitly or inherently equivalent to a process having a reactor producing an effluent which is then subsequently cooled to a similar temperature.

The presently claimed POX reactor and the LeBlanc autothermal reformer are different in operating conditions (catalyzed/non-catalyzed, temperatures, etc.), feed compositions, product compositions (relative proportions of CO, CO_2, H_2, and in the amount of carbon or soot produced), etc., and applicant's use of direct and/or indirect heat exchange to cool the POX reactor effluent indicates that there can be no equivalence between the two very different reactors. The LeBlanc process as disclosed would not work simply by substituting a POX reactor for the autothermal reactor, and there is no motivation, suggestion or guidance to even try this, let alone an expectation of success in doing so.

The office action correctly notes that *LeBlanc* discloses that the exit temperature of the exothermic catalytic steam reformer is preferably between 900°C and 1100°C, which overlaps the claimed range of cooled effluent at 650°C to 1000°C. This demonstrates only that the first reformed effluent per se without any intermediate heat recovery or cooling step might have a temperature within the range from 650°C to 1000°C. However, an inherency rejection requires that the claimed result must necessarily obtain from the cited reference, not merely that it

could have obtained. Similarly, LeBlanc does not disclose or suggest the specific feed splits in new claim 35, nor the specific feed splits for enhanced hydrogen production and enhanced CO production specified in claims 36 and 37, as discussed in paragraph [0009]. These different feed splits and feed split modes further emphasize the novel and nonobvious differences between the ATR-KRES configuration in LeBlanc and the POX-heat recovery-KRES configuration as claimed.

Moreover, this basis asserted for rejection would overlook the requirement for the affirmatively recited process step of cooling the effluent to the stated temperature to be effected upstream from the second reactor. Moreover, the clear teaching of *LeBlanc* to use the mode of operating the first reactor as a means of controlling the effluent temperature is directly contrary to applicant's claimed process wherein the first reactor effluent is subjected to a distinct cooling step. The cooling of the first reactor effluent, including the ability to recover heat from the first reactor effluent upstream from the reforming exchanger at a higher temperature (see claims 27 and 29, for example), is a new result that was not at all obvious from *LeBlanc*.

To form a proper 102(b) rejection, the prior art reference must explicitly or implicitly disclose each element in the specific manner claimed by applicant. *LeBlanc* shows neither the reactor claimed nor the cooling step as specified, and thus a 102(b) rejection of claim 1 with respect to *LeBlanc* is not proper. Similarly, dependent claims 2-13 include the limitations of claim 1, and are likewise not anticipated by *LeBlanc*.

Regarding new claim 22, *LeBlanc* does not teach the use of a non-catalytic partial oxidation reactor. Regarding new claim 23, *LeBlanc* does not teach the use of a free-flow, unpacked, non-catalytic partial oxidation reactor.

Regarding new claim 24, *LeBlanc* does not teach that the effluent from the partial oxidation reactor can be greater than 1100°C.

Regarding new claim 25, *LeBlanc* does not teach the use of a non-catalytic partial oxidation reactor, nor does *LeBlanc* teach that the effluent from the partial oxidation reactor can be greater than 1100°C. Claims 26 – 37 depend from claim 25 and are likewise not anticipated by *LeBlanc*.

§ 103 Rejections

As shown above, *LeBlanc* does not teach each element in claim 1. The secondary references, *Henningsen* and *Cizmer*, likewise do not teach or suggest either a POX type reactor or cooling upstream from the KRES unit, and thus fail to bridge the gap between *LeBlanc* and claim 1. As such, a prima facie case of obviousness can not be established, as the purported combination of these references does not result in all the claim limitations. Moreover, even if it did, no suggestion or impetus to combine the references in this manner can be found in the references relied upon.

Henningsen discloses contacting syngas with quench water to cool the syngas, but like *LeBlanc*, does not teach the use of a POX reactor and the subsequent cooling step(s). Neither *Henningsen* nor *LeBlanc* teach or suggest that the proposed quench should be used in combination with the POX reactor and the KRES reformer-exchanger as disclosed by applicant. As a result, even if there were motivation for their combination, the proposed combination of *LeBlanc* and *Henningsen* would still not have obtained applicant's claimed invention since it does not teach or suggest all of the elements of claim 1 or claims 2-4. The rejection under 35 U.S.C. § 103(a) should be withdrawn.

Referring to claim 4, the cross exchange, as described in paragraphs [0009] and [0015] of the specification, involves recovering heat from the POX effluent to preheat the feed supply for the KRES catalyst tubes. The cross exchange does not

refer to the heat exchanged within the KRES, thus the rejection of claim 4 is improper.

Cizmer discloses a KRES-type reformer-exchanger wherein the tubes are adapted to hold catalyst therein and allow passage of reactant fluid, but again like *LeBlanc,* does not teach the use of a POX reactor and the subsequent cooling step(s) in the specified flow configuration. The rejection under 35 U.S.C. § 103(a) is improper and should be withdrawn.

During the course of these remarks, Applicant has at times referred to particular limitations of the claims which are not shown in the applied prior art. This short-hand approach to discussing the claims should not be construed to mean that the other claimed limitations are not part of the claimed invention. Consequently, when interpreting the claims, each of the claims should be construed as a whole, and patentability determined in light of this required claim construction. Unless Applicant has specifically stated that an amendment was made to distinguish the prior art, it was the intent of the amendment to further clarify and better define the claimed invention.

If the Examiner has any questions or comments regarding this communication, he is invited to contact the undersigned directly to expedite the resolution of this application. Further examination of the application and reconsideration of the claims as originally presented and the allowance thereof is respectfully requested.

Respectfully submitted,

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